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DECLARATION OF TRANSLATOR

I, Lawrence B. Hanlon, of the International Translation Center, Inc., do hereby avow and declare that I am conversant with the English and German languages and am a competent translator of German into English. I declare further that to the best of my knowledge and belief the following is a true and correct translation prepared and reviewed by me of the document in the German language attached hereto.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of any patent issued thereon.

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Construction-Kit System

The invention relates to a construction-kit system having at least one primary valve block with at least two groups of connecting lines all of which are interconnected at one point by a connecting line of one group so as to conduct fluid.

DE-OS 27 50 035 discloses a hydraulic module consisting of small hydraulic elements which are interlinkable by way of their height and surface and performing pressure and/or quantity varying or distributing or controlling functions and a base block, the connection pattern of the elements and the base block being configured to be point symmetric and being in the form of two connecting bores and two fastening bores and, in addition, the elements and the base block being mounted in a predetermined pattern and/or sequence and so as to be rotated around the longitudinal axis through an angle of 180° relative to each other. A space-saving design is thereby obtained for the interlinkable hydraulic elements in question.

EP 0 854 982 B1 discloses a modular primary valve block of a valve system having pilot-controlled seat and/or piston valves, a primary valve block which has both a standardized connection interface and a pilot valve interface for mounting of a pilot valve and which has a

pump line, a tank line, a first operating line, a second operating line, a first control line, and a second control line, and in which four valve seats are mounted, each for mounting one valve unit. The respective solution has proved to be suitable especially for cartridge technology in which valve units (cartridges) suitable for a particular application are mounted on the primary valve block.

DE 199 21 436 A1 discloses a hydraulic system for supplying a hydraulic consumer in motor vehicles, one which reduces the cost of designing different alternatives. In this disclosed hydraulic system a pressure or hydraulic tank is provided in which a hydraulic means is stored and may be pressurized and all components of the hydraulic system configured as support housing are mounted so that they form a completely mountable assembly unit. The disclosed solution also has a hydraulic means pump which delivers the hydraulic means from or to the pressure tank, an electric motor also being provided for driving the hydraulic means pump, as well as a control device for controlling operation of the electric motor. A pressure accumulator which stores pressure in the form of potential energy and applies this pressure to the hydraulic means of the pressure tank and the pump module in the interior of the pressure tank and the other modules are mounted externally on the pressure tank. The respective disclosed configuration of a hydraulic system provides a modular system by which a plurality of functions may be performed.

The disclosed solutions are not, however, suitable for meeting the increasingly complex system requirements set for hydraulic systems. The control expenditures for such hydraulic control units and associated assembly components has increased so that more and more individual solutions are being sought rather than modular concepts, since the disclosed modules or components as supplements to a hydraulic module normally do not sufficiently justify the increased system and control expenditures.

On the basis of this prior art the object of the invention accordingly is further to improve the disclosed solutions by providing a modular system which may be produced in a cost-effective and space-saving manner, a system which is reliable in operation and meets the increasingly rigorous requirements set for the complexity of functions potentially assigned for a hydraulic system as a whole. The object as thus described is attained by means of a modular system having the features specified in patent claim 1 in its entirety.

In that, as specified in the descriptive part of patent claim 1, at least two other connecting lines of this one group are connected to an associated connecting line of the other group of the primary valve block, and in that at least three dummy components are connected to the connecting lines of the other group for use of specified valve components, and in that at least two other dummy components are connected between a common connecting line of the other group and another associated connecting line of this other group, a dummy component solution is provided on the basis of the primary valve block as main component of the modular system claimed, a dummy component which permits use, as a function of the function assigned to the system and as a function of the components otherwise to be built into the modular system, of individual valve components for each dummy component which then as a whole, together with the other components, perform the function assigned to the system. The dummy components referred to, in conjunction with the connecting lines referred to for the primary valve block, configure a sort of matrix structure having transverse and longitudinal rows, the dummy component solution claimed for the invention, together with the matrix-like connection structure, making it possible to perform a decidedly large number of system functions. The respective solution is space-saving in its structure and accordingly cost-effective in production, as well as reliable in operation. Once primary valve blocks are in operation as basic system for the respective hydraulic module, they may easily be modified on the spot should modified system functions make this necessary.

By preference provision is also made such that at least one dummy component of a valve component remains unoccupied or blocks the respective fluid-conducting path of one or more connecting lines of one or the other group or forms a fluid-conducting path between connecting lines of the other group. While the other dummy components accordingly are occupied by valve components, the dummy component which remains free permits appropriate fluid control inside the primary valve block as determined by the function assigned to the system.

In a preferred embodiment of the modular system claimed for the invention the primary valve block has on the outer circumference side connecting points for optional or partly common connection of other components such as pressure gauges, hydraulic pumps, cooler and/or filter units, hydraulic accumulators, other valve components, hydraulic tanks, electric and electronic control components including sensors and switching magnets, as well as at least one intermediate or secondary connection block. Hence, in order not only for integral valve components inside the primary valve block to be used, but also for it to be possible to connect to the primary valve block more extensive components mounted on the outer circumference side, the variability of the primary valve block is perceptibly increased while the primary valve block system component remains compact. By preference provision is also made such that the intermediate or secondary connection block is provided with additional dummy components, it being possible to use such components as pressure control valves, return valves, controlled switching valves, etc. as valve components for the dummy components and their selection being based primarily on the respective assigned system function.

In one especially preferred embodiment of the modular system claimed for the invention the respective hydraulic tank is designed as a module and may be selected from among a large number of hydraulic tanks having the respective connection points for the purpose of complementation by the other components of the module and different tanks volumes selected in

specified stages. It has been found to be especially advantageous to provide hydraulic tanks with capacities of 25, 50, 100, 150, and 200 liters and such tanks have been designed so that they fit one within the other and may be placed on half of a EURO pallet for shipping purposes.

One aspect of the modular system concept is that it permits complete delivery of system components, in particular a hydraulic tank, hydraulic pump with associated electric motor, valve blocks with pressure, direction, and flow valves, including filter units, hydraulic accumulators, oil coolers, air coolers, and accessories. As regards the modular construction, the user retains the option of obtaining all components from a single manufacturer or, as a backup measure, obtaining them from other manufacturers. Consequently, the modular system claimed for the invention provides a solution to a great extent permitting user-specific complementing of total hydraulic systems.

The modular system claimed for the invention will be described in what follows on the basis of exemplary embodiments with reference to the drawing, in which, in diagrammatic form not drawn to scale,

FIGS. 1 to 4, in the form of connection diagrams, illustrate four different system solutions;

FIG. 5 presents a perspective top view of a hydraulic system made up of individual modular components.

FIG. 1 illustrates a connection diagram of a primary valve block 10 having at least two groups 12, 14 of connecting lines all interconnected at one point 16 by a connecting line of one

group 12 so as to conduct fluid, at least two other connecting lines of this one group 12 being connected to an associated connecting line of the other group 14; at least three dummy components 18 are connected to the connecting lines of the other group 14 for use of specified valve components, and at least two other dummy components 20 are switched between a common connecting line 14a of the other group 14 and another associated connecting line 14b of this other group 14.

On the basis of the basic concept shown in FIG. 1, FIGS. 2 to 4, also in diagram form, illustrate various embodiments of hydraulic solutions, ones in which the dummy components 18, 20 are occupied by valve components. Thus, the circuitry solution illustrated in FIG. 2 has for each of the two dummy components 18 on the right as viewed in the line of sight to the figure a pressure control valve 22, while in the left half of the figure the dummy component 18 is occupied by a return valve 24. The dummy component 20 on the right is provided with an adjustable choke 26 and the other dummy component 20 on the very left permits establishment of a fluid-conducting path 28 between connecting lines 14, 14b of the respective other group.

In a correspondingly modified embodiment shown in FIG. 3 the respective dummy components 20 may also be provided with a device 30 blocking the fluid path 28 or, in an embodiment not shown, a respective dummy component 18, but preferably 20, may also remain entirely unoccupied, depending on the total hydraulic system it is desired to produce.

In addition, the primary valve block has on the external circumference side connecting points 32 (see FIG. 1) for optional or partly common connection of additional components such as pressure gauges 34, hydraulic pumps 36 with electric drive 60, cooler units 38 (see FIG. 5), filter units 40, hydraulic accumulators 42, other valve components 44, hydraulic tanks 46, electric and electronic control components 48 (see FIG. 2), and at least one intermediate or

secondary connection block 50 (see FIG. 4). As the individual circuit diagrams show, the respective dummy component 18, 20 may have valve components such as pressure control valves 22, return valves 24, chokes 26, or diaphragms and switching valves 52, such as ones for example in the form of the 4/3-way valve shown in FIG. 3, or components in the form of pressure scales 54 (see FIG. 4).

As is to be seen in FIG. 4 in particular, the primary valve block 10 is there combined with an intermediate or secondary connection block 50 which is appropriately mounted on one of its front sides. The respective intermediate or secondary connection block 50 is provided with additional dummy components 56 in which, in turn, appropriate valve components may also be mounted as already explained, as a function of the solution for the respective system task. In addition, it has been found to be advantageous for the sake of a reliably operating and compact design, such as that illustrated by the basic circuitry in FIG. 1, to assemble the respective dummy components 18, 20 of the primary valve block 10 in function groups, one in a group of two and one in a group of three, spatially separated from connecting lines of one group 12. The function group on the left as viewed in the line of sight to FIG. 1 consists of one dummy component 18 and an additional dummy component 20, while the function group on the right consists of two dummy components 18 and one additional dummy component 20. In another embodiment not shown the circuits are provided with six dummy components and division by integral multiples of dummy components is effected.

The illustration in FIG. 5 presents a hydraulic system having a plurality of modular components as already described. The basic housing element is represented by the hydraulic tank 46 referred to in the foregoing, which as a module is made up at option of a plurality of hydraulic tanks which have the connecting points indicated (not shown) for complementation with the other components of the module and which have different tank volumes (fitting on

EURO pallets) selected at option in specified stages. The hydraulic tank 46 has as accessory 58 on its front side facing the observer a level indicator and on the top side the electric motor 60 is mounted which drives the hydraulic pump 36 extending into the tank 46. The cooler unit 48 is mounted on another frontal side of the hydraulic tank, while the primary valve block 10 and the intermediate and secondary connection block 50 with various switching valves is mounted on the top side of the hydraulic tank 46 beside the hydraulic accumulator 42.

The modular system shown complemented in FIG. 5 may accordingly be delivered as requested by the customer but also in the form of individual components; a customer may order such user-specific components from third-party manufacturers and then produce a total hydraulic system in accordance with his own guidelines and quality concepts.